



# Continued Operation of Darlington Nuclear Generating Station.

An Impact Analysis on Ontario's Economy

## At a Glance

- Darlington Station's economic footprint from continued operation is expected to represent a \$75-billion increase to Ontario's nominal GDP from 2017 to 2055, or \$1.9 billion per year.
- The boost to economic activity would have far-reaching and, effectively, permanent stimulative effects on the Ontario economy.
- Ontario's GDP will increase by \$89.9 billion due to the combined impact of refurbishing and operating Darlington from 2010 until 2055.

## Executive Summary

**Ontario Power Generation's (OPG) Darlington Nuclear Generating Station supplies approximately 20 per cent of Ontario's electricity needs.<sup>1</sup> Having been in operation since the early 1990s, the station is approaching the midpoint of its operating life. At this stage, its CANDU reactors require a major refurbishment to replace critical components. As a result, OPG is currently overseeing a 17-year, \$12.8-billion<sup>2</sup> refurbishment project that is designed to allow the station to continue operating safely until 2055.**

The Conference Board of Canada was commissioned to estimate the economic impact on Ontario of continuing to operate Darlington Station from 2017 to 2055. To achieve this, the Conference Board relied on detailed information about nuclear operating costs provided by OPG. The information included planned expenditures by year and the type of spending. This provided enough data to perform detailed economic simulations that were used to estimate the impact on Ontario's economy of continuing to operate Darlington Station.

An input-output (I-O) economic modelling framework was used to estimate the station's direct, indirect, and induced effects on the province's economy. The direct effect includes the production value of economic agents who are directly involved with Darlington (e.g., workers and firms). However, to complete their work, these agents need to purchase services and materials from suppliers who also require materials and supplies. This sets an economic chain reaction in motion, whereby industries supply inputs to other industries that are directly

1 Canadian Nuclear Society, *Nuclear Canada Yearbook 2015*.

2 This is the escalated (i.e., nominal) spending estimate that includes \$1.5 billion in interest payments.

involved in the station. The economic impacts of this chain reaction represent the indirect (or supply chain) effects. Finally, induced effects follow, largely due to the widespread impact of employees spending their wages, and businesses reinvesting the profits earned from Darlington's direct and indirect activities.

Statistics Canada's detailed model of Ontario's industrial structure was used to capture the direct economic impact of continuing to operate Darlington Station, and the supply chain impacts of the station's expenditures. Results from these inputs then guided simulations using the Conference Board's own proprietary model of the Ontario economy to estimate the full economic impact of operating the station until 2055. Using two models enabled us to take full advantage of the unique strengths of each. In particular, the Statistics Canada model has a more detailed breakdown of industries by region, which allows for a more accurate estimation of the indirect effects. Similarly, the Conference Board's model is more dynamic and provides results for a wider range of indicators, enabling detailed modelling of prices, interprovincial migration, the government sector, households, and businesses.

Our analysis shows that the economic footprint associated with continuing to operate Darlington Station is expected to represent a \$75-billion increase to Ontario's nominal GDP from 2017 to 2055. The boost to economic activity would have far-reaching and, effectively, permanent stimulative effects on Ontario's economy. Continued operation of the station is projected to increase the number of jobs in Ontario by an average of 14,200 per year between 2017 and 2055, with 5 jobs created in the broader Ontario economy for each worker directly employed at Darlington Station. In other words, the operational expenditures associated with the station until 2055 will lift employment by roughly 555,000 person-years in Ontario over the life of the station. Also, the effective permanent footprint of Darlington will serve as a critical source of job creation for Ontarians, both within and beyond the utilities industry. The combined impact of the station's refurbishment and continued operation is projected to increase employment by 704,000 person-years between 2010 and 2055.

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The ongoing operation of Darlington is expected to raise personal income in Ontario by an average of \$1.6 billion per year from 2017 to 2055.

Increased employment and GDP stemming from Darlington Station's continued operation will translate into increased income for households and businesses as a result of the station's indelible economic footprint. The ongoing operation of Darlington is expected to raise personal income in Ontario by an average of \$1.6 billion per year from 2017 to 2055, for a total of \$61.4 billion. The enrichment of Ontario households is expected to translate into more robust consumer spending—a boost of \$53.4 billion over the life of the station, or an average of \$1.4 billion per year—with no net change in the household savings rate. This amount is projected to be distributed across a wide spectrum of household consumption categories for goods and services—including shelter, food, clothing, and vehicles. Similarly, corporate profits before tax would increase by \$7 billion over the same 39-year period.

Accordingly, ongoing operation of Darlington is expected to increase residential construction by \$2.2 billion. Moreover, the station's footprint will increase other non-residential business investment by another \$3.3 billion as corporations reinvest profits in the Ontario economy. Imports and exports are also projected to increase by \$14 billion and \$11 billion, respectively, between 2017 and 2055.

Higher labour income, increased corporate profits, and the purchase of supplies, raw materials, and services will all contribute to increasing government tax revenues. The ongoing operation of Darlington Station is forecast to result in a \$9.3-billion cumulative increase in revenues for the Ontario government. Meanwhile, the federal government will collect \$13.8 billion in revenue, while Ontario municipalities will collect \$356 million. This will add a total of \$23.4 billion to government coffers over the span of Darlington's operation.

The economic impact analysis allows for the calculation of multipliers, which are rules of thumb that associate the ongoing operation of Darlington Station with employment and overall economic activity. The station's operation has an elevated total multiplier of 1.4. This means that, on average, for every \$1 of operational spending, Ontario's GDP will increase by \$1.40. Furthermore, the type II multiplier of 2.3 indicates that the total impact of operating Darlington Station until

2055 is more than twice as large as the contribution of the utilities industry GDP associated directly with the station's operation. This multiplier reflects the extensive supply chain and economic footprint generated by Darlington beyond the utilities industry. These multipliers are considered elevated, which can be attributed to the low import content of operating Darlington Station.

## Darlington Station Operation

### Introduction

Since its first reactor entered service in 1990, Darlington Nuclear Generating Station, operated by Ontario Power Generation (OPG), has produced more than 560-million megawatt-hours (MWh) of electricity from its four CANDU reactors—about equivalent to Canada's total annual energy consumption. Today, Darlington has a generating capacity of approximately 3,600 megawatts (MW),<sup>3</sup> and produces about 20 per cent of Ontario's electricity needs.<sup>4</sup> Having been in service for well over two decades, Darlington Station is undergoing a \$12.8-billion refurbishment investment that is designed to allow for its ongoing safe operation until 2055.<sup>5</sup> This investment represents the escalated (i.e., nominal) estimate of the costs, including interest payments of about \$1.5 billion. Throughout this briefing, escalated costs are used to describe the project and its impacts.

The Conference Board of Canada was commissioned to estimate the economic impact in Ontario of Darlington Station's continued operation during and following refurbishment until 2055. The first part of this briefing provides an overview of the station's ongoing operation. The second part describes our methodology and assumptions, followed by the findings of our economic impact analysis.

3 Ontario Power Generation, *Performance Report*.

4 Canadian Nuclear Society, *Nuclear Canada Yearbook 2015*.

5 Ontario Power Generation, *Darlington Refurbishment*.

## Nuclear Power in Ontario

There are currently three nuclear generating stations in Ontario: Darlington, Bruce, and Pickering. In 2015, these three plants generated 92.3-million MWh of electricity, constituting 60 per cent of the total 153.7-million MWh produced in the province. (See Table 1.)

**Table 1**  
**Electric Power Generation in Ontario by Type of Fuel (2015)**

Fuel type	Share of production (percentage)
Nuclear	60.1
Hydro	23.6
Gas/oil	10.0
Wind	5.9
Biofuel	0.3
Solar	0.2
Coal	n.a.

Sources: Independent Electricity System Operator (IESO); The Conference Board of Canada.

For more than a decade, the Ontario government was committed to eliminating its reliance on coal for generating electricity.<sup>6</sup> The province achieved this goal in 2014, when it closed its last coal-fired plant.<sup>7</sup> During this period, the province's reliance on nuclear power increased significantly. The share of power generated in Ontario from nuclear steam turbines increased from 42 per cent in 2003 to 60 per cent in 2015. (See Chart 1.)

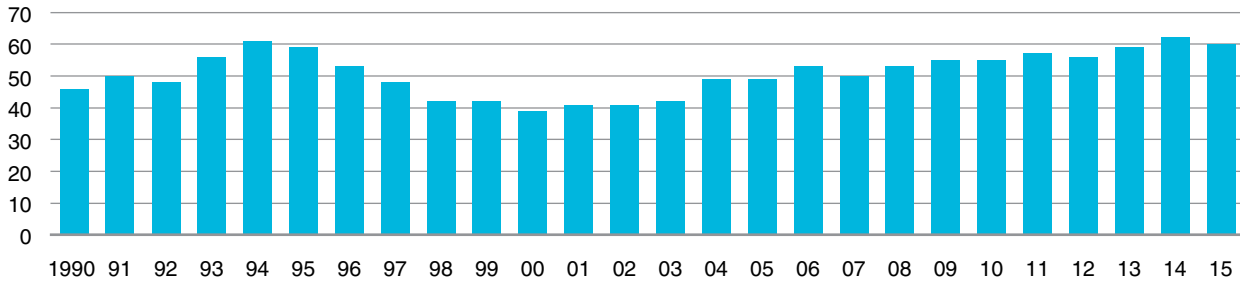
6 Gross, "How Ontario Is Winning the War on Coal."

7 Ontario Newsroom, *Creating Cleaner Air in Ontario*.

Chart 1

**Share of Nuclear Power Generation Produced in Ontario by Year**

(percentage)



Sources: The Conference Board of Canada; Statistics Canada, CANSIM tables 127-0001 and 127-0002; Independent Electricity System Operator ([www.ieso.ca/Pages/Power-Data/Supply.aspx](http://www.ieso.ca/Pages/Power-Data/Supply.aspx)).

**Continued Operation**

The Conference Board received some details about the ongoing operation of Darlington from OPG. The station’s combined costs for operations, investments, and fuel are approximately \$1.4 billion per year in current dollars (\$1.2 billion in 2015 real dollars). Operating costs include labour compensation and purchases of goods and services. This includes the compensation of staff residents at Darlington Station, as well as the share of compensation of OPG’s nuclear support and corporate support staff that may be allocated to Darlington on a proportionate basis.

Darlington Station typically employs about 2,300 to 2,600 workers, including regular staff and those performing various support functions. The majority of the regular station staff (63 per cent) live in the Regional Municipality of Durham, while the remaining reside largely in Northumberland County, the City of Peterborough, and Peterborough County. Supplemental workers are brought in to support scheduled maintenance outages (these can be large such as the 2015 Vacuum Building Outage project, which required 1,800 supplemental staff). Post-refurbishment, it is expected that direct station staff, nuclear support staff, and allocated corporate support staff will total about 2,600 to 2,800 on a full-time equivalent basis to support continued operation.

Every year, OPG also contributes to government revenues in several ways, including \$4 million in property taxes to the Municipality of Clarington and an equivalent amount to the Province of Ontario. Through its Corporate Citizenship Program, OPG provides annual community investment support to Durham Region through more than 300 initiatives that focus on environment, education, and community (approximately \$600,000 a year, or 25 per cent of the program community investment). Since 1999, OPG's Corporate Citizenship Program has provided \$10.4 million in support to Durham Region. It has also provided \$20 million in collaborative educational partnerships with the University of Ontario Institute of Technology (UOIT) and Durham College. In May 2016, OPG announced phase three of this partnership—a \$5-million investment. Approximately \$1 million in support has been provided to UOIT via the Universities Network of Excellence in Nuclear Engineering. These corporate social responsibility initiatives provide economic benefit to the greater community, in addition to the economic impact resulting from the continued operation of Darlington Station, as this briefing details.

## Economic Impact Analysis

### Key Assumptions

Starting in October 2016, OPG will begin refurbishing Darlington Station in Clarington, Ontario. The refurbishment project—consisting of the 2010–15 definition phase and 2016–26 execution phase—is expected to comprise a total investment of \$12.8 billion from 2010 to 2026, including cost escalation associated with expected increases in the price of goods and services. This represents escalated (nominal) figures. The total investment figure also incorporates the \$1.5-billion cost associated with interest payments to be made by OPG to the Ontario Electricity Financial Corporation (OEFC) on loans borrowed to complete the refurbishment.

This briefing is a continuation of the Conference Board's November 2015 briefing *Refurbishment of the Darlington Nuclear Generating Station*, which provided a detailed analysis of the economic impact of refurbishing



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The objective of this briefing is to estimate the economic impact on Ontario associated with the continued operation of Darlington from 2017 to 2055.

Darlington Station. The objective of this briefing is to estimate the economic impact on Ontario specifically associated with the continued operation of Darlington from 2017 to 2055.

The Conference Board received detailed information from OPG's *Darlington Refurbishment Business Case Summary* regarding the expenditures associated with ongoing nuclear operation of the station from 2017 to 2055. Four broad nuclear operating cost categories were considered in this analysis to inform specific modelling assumptions:

- **Station expenditures:** For the purposes of this assessment, station expenditures include base operating, maintenance, and administration (OM&A) costs;<sup>8</sup> outage OM&A;<sup>9</sup> project capital and OM&A; and minor fixed assets (MFA). It is assumed that labour costs comprise 70 per cent of station expenditures, with the remaining 30 per cent allocated to materials costs.
- **Station support expenditures:** Support expenditures consist of base OM&A funding for support groups allocated to Darlington Nuclear Generating Station, including Nuclear Support and Corporate Support.<sup>10</sup> Labour and material costs are assumed to account for 85 per cent and 15 per cent, respectively, of station support expenditures.
- **Fuel and fuel-related costs:** Fuel is assumed to encompass two-thirds of total fuel and related costs, with uranium accounting for one-third of fuel costs. Sources of uranium concentrate are assumed to be primarily out of province, with the supply chain concentrated in Saskatchewan,

- 8 Base operating costs are calculated as station direct costs plus low and intermediate level waste (L&ILW) costs, minus the cost of goods sold for other revenues. As per OPG's February 2013 report, *OPG's Deep Geologic Repository Project: For Low and Intermediate Level Waste*, L&ILW costs are associated with the secure storage of "industrial items that have become contaminated with low levels of radioactivity during routine clean-up and maintenance."
- 9 Outage OM&A consists of direct station costs and support provided, or work conducted by Nuclear Support groups, which include Nuclear Engineering; Decommissioning and Nuclear Waste Management; Fleet Operations and Maintenance; Inspection and Maintenance Services; Security and Emergency Services; and Projects and Modifications.
- 10 Corporate Support groups include Business and Administrative Services; Finance, People, Culture and Communications; Commercial Operations and Environment; and, Executive Office. Other corporate costs, such as insurance, are also included under the general umbrella of corporate support, but are not allocated to the aforementioned groups.

Australia, and Namibia. All refining, conversion, and fuel manufacturing activities occur in Ontario in this analysis. Used fuel dry storage and used fuel storage costs are calculated as average annual monies set aside in provision funds, and are included in fuel and fuel-related costs.

- **Property taxes:** OPG pays an estimated \$4 million in property taxes each year to the Municipality of Clarington, and an equivalent amount to the Province of Ontario.

Please note that, for sections pertaining to the joint impact of refurbishing and continuing operation of Darlington Station, interest payments made by OPG to the OEFC were not included in our model simulations. Therefore, the total amount of the investment shock attributed to refurbishment was \$11.3 billion in nominal terms.

## Concepts and Definitions

The economic impact of any investment in the economy can be divided into three types of effects: direct, indirect, and induced. Direct effects capture the economic value generated by economic agents, specifically workers and firms, involved in production and income-generating activities. Workers and firms need to purchase services and materials from suppliers to complete their work. These suppliers also require materials and supplies. This sets an economic chain reaction in motion, whereby industries supply inputs to other industries that are directly involved with the station. The economic impacts of this chain reaction are referred to in this briefing as the “indirect effects.” The induced effects that follow arise from the reactions of economic agents when production (and therefore income) increases. The majority of induced effects are due to the spending of income associated with the employment created by the initial impact of a project. However, reinvestment of corporate profits in expansions of plant capacity or replacement of depreciated capital stock can also elicit induced effects.

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Total expenditures (or revenues) associated with operating Darlington do not result in a one-to-one increase in GDP.

The analysis undertaken, which is discussed in the next section, used a two-step process to evaluate the combined direct, indirect, and induced economic impacts from 2017 to 2055, in which:

- Direct impacts were first assessed as the change in value-added to the Ontario economy of the contribution to utilities output attributed directly to the operation of Darlington Station. Value-added, or net output, is calculated as the difference between total revenue (or gross output) and the sum of expenses on parts, materials, and services used in the production process. The sum total of value-added across all industries in a region yields regional GDP.
- Indirect impact measures the value-added that the direct impact firms generate through their demand for intermediate inputs or other support services. Several industries contribute indirectly to the ongoing operation of Darlington. The most significant include fuels; inorganic chemicals; computer systems design; engineering; management, scientific, and technical services; and repair and maintenance.
- Induced impacts are incurred when employees of industries affected by direct and indirect impacts spend their earnings and companies spend their profits. These purchases lead to more employment, wages, income and tax revenues, which affect a wide range of industries.

As a result, increased demand for the goods and services of a specific industry will have direct economic impacts; the influence of which will also spread through the economy as a result of a series of multiplier effects. Indirect effects first affect demand in industries that are direct suppliers. Second-round, induced effects produce a widespread, although usually smaller, impact on all sectors of the economy—largely through a general increase in consumer spending.

It is important to note that total expenditures (or revenues) associated with operating Darlington do not result in a one-to-one increase in GDP. This is because the purchase of goods and services associated with the station will have leakages associated with purchased inputs and services. For example, demand for fuel, transportation services, or manufactured products will require intermediate inputs purchased from suppliers who may be outside regional and national boundaries.

The dependence of the supply chain on imported components will determine the level of leakages and the extent to which there is a reduction in the overall economic multiplier. Depending on the import content of the inputs for each industry, the economic multipliers can vary significantly. Because Ontario is an important supplier of professional, scientific, and technical services, as well as engineering and architectural services, the province has a large multiplier associated with the operation of nuclear reactors relative to other regions in Canada. Moreover, Ontario's manufacturing base enables the province to gain a relatively larger share of the benefits associated with induced increases in consumer spending and business investment.

## **Methodology**

The economic impact analysis was carried out using a two-step process. Statistics Canada's provincial input-output (I-O) model simulations—based on a custom production function specific to the nuclear power generation industry in Ontario—were first used to identify detailed supply chain impacts associated with the ongoing operation of Darlington. Results from these simulations were then input into the Conference Board's provincial forecasting model to estimate the full range of economic impacts stemming from the station's operation.

The Conference Board's provincial forecasting model captures the sum of direct, indirect, and induced impacts on Ontario's economy, based on estimated historical relationships. The model incorporates a detailed modelling of prices, households, and businesses, and provides economic impact results for a wide range of economic indicators. The simulations were produced for the 2017 to 2055 timeframe to reflect the value of continuing to operate Darlington Station. The Conference Board's latest long-term economic forecast of the Ontario economy provided the backdrop for the impact analysis.

Darlington Station typifies the complex nature of operations in the nuclear power generating industry. As such, the research relied on Statistics Canada's detailed model of Ontario's industrial structure to assess the direct and indirect effects associated with the expenditures

and activities related to the station's ongoing operation. The Statistics Canada interprovincial I-O model finely details the industrial structure within an industry, and the linkages of input commodities to other industries.<sup>11</sup> Since many of these links are unpublished due to confidentiality, Statistics Canada has the advantage of being able to more accurately assess, on a national and regional basis, both the direct and indirect effects of the specific investment profiles provided.

However, while the I-O analysis is important for measuring detailed supply chain effects, the economic impact results of Statistics Canada's model are static and limited to industrial and employment impacts. To generate impacts over time and quantify induced impacts, additional simulations were performed using the Conference Board's provincial economic model. This model contains a less detailed industrial sector. However, it has the benefit of assessing the impact of additional income on the regional economies through changes in employment, labour income, and profits. Moreover, it incorporates a dynamic modelling of prices, government sector, households, and businesses, providing economic impact results over time and for a wider range of economic indicators.

## **Results: Continued Operation Impact**

### **GDP and Multipliers**

Table 2 presents the economic impact results of the expenditures related to the continued operation of Darlington Station until 2055. The table displays the cumulative sum of operational spending and economic benefits, and the annual average impact from operating the station for another 39 years. Yearly results are provided in more detail in the data tables in Appendix B.

11 Statistics Canada's regional I-O model breaks down close to 300 industries and more than 700 commodities. The 2010 I-O model, just completed in November 2014, was used for the analysis. For more information, see Statistics Canada, *Input-Output Model Simulations*.

Our analysis shows that the ongoing operation of Darlington Station will boost Ontario's nominal GDP by a total of \$75 billion from 2017 to 2055. Adjusting for inflation, the station will increase real GDP by \$53.9 billion in 2015 dollars. (Due to inflation, dollar amounts in the future years of the project (2017–55) will be worth less than they are today. The “real GDP” figure cited here converts the impact on GDP into present-day dollars, which makes it easier to appreciate or interpret the value of the benefits.)

When the total nominal GDP impact is compared with total operational spending of \$55.3 billion, it yields a total multiplier of 1.4. (See Table 2.) This means that every \$1 of nuclear operation expenditures earmarked for the continued operation of Darlington Station is expected to increase Ontario's GDP by \$1.40 due to the direct, indirect, and induced effects of the ongoing nuclear expenditures. The GDP multiplier (or type II multiplier) is 2.3, such that for each \$1 of GDP generated directly by Darlington's operation, the total impact on Ontario's GDP is \$2.30. (See “The Four Different Types of Recognized Multipliers.”)

**Table 2**  
**Economic Impact of Darlington's Continued Operation**

	2017–55 Total	Average (2017–55)
Total nuclear operational expenditures (current \$ millions)	55,259	1,417
GDP at market prices (\$ millions)	75,046	1,924
Personal income (current \$ millions)	61,397	1,574
Labour force (000s)	402.0	10.3
Employment person-years (000s)	555,013	14,231
Housing starts	1,688	43
Multiplier		1.4

Source: The Conference Board of Canada.

The total multiplier is considered elevated due to the relatively low import content of Darlington Station's ongoing operation. Moreover, the multiplier is high because of Ontario's large manufacturing base, which enables the province to capture a relatively elevated share of the production, and income, from both indirect and induced effects.

When considering the combined impacts of the refurbishment and operational phases of Darlington Station, Ontario's nominal GDP is estimated to increase by a total of \$89.9 billion from 2010 to 2055. For the refurbishment phase of Darlington Station, this figure consists of the \$12.8 billion in total investment minus interest payments of \$1.5 billion. Interest payments were excluded from the multiplier calculations because they were not included in our economic impact analysis, except as government revenues. When compared to aggregate refurbishment investment and nuclear operational expenditures of \$66.5 billion for those two phases, this generates a total multiplier of 1.4.

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## The Four Different Types of Recognized Multipliers

Economic impact studies often refer to multiplier effects when describing their results. However, the type of multiplier described is rarely mentioned. In some cases, this can create confusion since there are four types of recognized multipliers that can be derived from an economic impact analysis: simple, total, type I, and type II multipliers.<sup>12</sup> In addition, each of these four can refer either to GDP or to jobs, yielding a combination of eight different multipliers.

The analysis estimates that operating Darlington Station until 2055 will result in a total GDP multiplier of 1.4. The difference between a total multiplier and a type II multiplier is the denominator. The total multiplier uses the amount of spending as the denominator (in this case, total expenditures on operation), whereas type II multipliers use the direct impact as the denominator. When assessing the impact of additional spending, the direct impact is typically smaller than total spending, conditional on the amount of goods and services purchased through the supply

12 Statistics Canada, *Input-Output Model Simulations*.

chain and imports. In cases when the direct impact is much smaller than the amount of spending, there will be large variances between the total multiplier and type II multiplier—however, the real economic impact is unchanged.

The following equations show how each is calculated:

- total multiplier = (direct + indirect + induced impacts)/investment amount
- type II multiplier = (direct + indirect + induced impacts)/direct impact

The simple and type I multipliers are similar to the total and type II multipliers, respectively, and differ only in that they do not include the induced impacts in the numerator.<sup>13</sup>

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## Employment

It is estimated that operating Darlington from 2017 to 2055 will increase employment levels in Ontario by a total of 555,000 person-years over the 39-year period. This translates into an increase of about 14,200 jobs per year in Ontario over that timeframe, creating approximately 5 jobs within the broader economy for every job at Darlington Station. An analysis of the impact reveals that the employment benefit will be incurred in a fairly consistent way over Darlington's lifespan.

It is important to note that these figures represent the number of additional jobs present in a given year, and not the number of jobs created during a specific year. (The implication of this statement is that it would not be advisable to add the number of additional jobs from two or more years together to create a total. Doing so would give the number of person-years of employment, but not the number of jobs created.) Factoring in the combined impact on employment of refurbishing and continuing to operate Darlington Station, employment levels in Ontario are projected to increase by 704,100 person-years between 2010 and 2055.

13 Ibid.



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The operation of Darlington until 2055 is expected to raise average provincial wages and salaries by \$48.8 billion.

The operational expenditures associated with the station's ongoing operation will also increase the size of Ontario's labour force, thereby increasing the province's productive capacity. By 2055, Ontario's labour force—the population that is eligible and willing to work—increases by 402,000, with an average increase to the labour force of 10,300 per year over the life of Darlington. This occurs due to two factors: Ontarians entering or re-entering the workforce, and interprovincial migration to the province. When demand for labour increases, as is the result in this analysis, job prospects improve, drawing more people into the workforce. The increase in the labour force participation rate can occur among all age groups, but is typical of younger cohorts who often opt to work when employment prospects improve, sometimes while remaining in school.

### **Household Income and Corporate Profits**

Increased employment and GDP translate into higher income for Ontario households and businesses. The operation of Darlington until 2055 is expected to raise average provincial wages and salaries by \$48.8 billion. Personal income—including income from all sources, such as investment interest and dividends, contributions of employers to pension plans, and rental property income—is expected to rise by a total of \$61.4 billion, or \$1.6 billion per year from 2017 to 2055. Similarly, the continued operation of Darlington is expected to raise pre-tax corporate profits by \$7 billion over the same timeframe.

### **Household Spending and Investment**

The increase in wages and salaries resulting from the continued operation of Darlington will increase household spending by \$53.4 billion between 2017 and 2055, or by an average of \$1.4 billion per year, with no net change in the household savings rate. It is projected that this amount will be distributed across a wide spectrum of household consumption categories for goods and services—including shelter, food, clothing, and vehicles.

Accordingly, Darlington is projected to increase residential construction by \$2.2 billion during its post-refurbishment period of operation. It will also increase other non-residential business investment by an additional

\$3.3 billion as corporations reinvest profits in the Ontario economy. This includes building structures and purchasing new machinery and equipment.

### **Trade**

Continued operation of Darlington is also projected to boost imports by \$14 billion and exports by \$11 billion over the station's lifespan. The large increase in international and interprovincial imports is partly due to the import of some project supplies (notably uranium concentrate from Saskatchewan). However, the primary cause for the surge in imports is the high import content of household, machinery, and equipment purchases resulting from the second-round "induced effects" described above. The rise in exports stems from international or interprovincial supply chain transactions due to stronger household income growth related to the ongoing operation of Darlington. For example, the station may require machinery and equipment purchases from Quebec. If the Quebec-based manufacturer needs to buy steel from Ontario to produce this machinery, then Ontario's exports to Quebec will increase.

### **Government Revenues**

Higher labour income, increased corporate profits, and the purchase of raw materials, supplies, and household goods and services contribute to higher government tax revenues. The continued operation of Darlington is projected to result in additional revenues of \$238 million per year for the Ontario government between 2017 and 2055, for a total of \$9.3 billion over the life of the station. Meanwhile, the federal government would collect \$354 million per year from operating Darlington Station until 2055, for a total of \$13.8 billion in revenue over the 39-year period. A larger proportion of personal and corporate income taxes accrue to the federal government since its tax rates are higher. Local municipalities in Ontario would collect \$9 million per year—consisting mainly of property taxes, developer lot levies, and deed transfer taxes—for a total of \$356 million incremental revenues by 2055.

The ongoing operation of Darlington means that, in total, the three levels of government will collect \$23.4 billion from 2017 to 2055, or an annual average of \$601 million. Due to the long-lived nature of the station, these increases in government revenue can effectively be considered permanent. (See Table 3.) Please note that the above figures do not include payments or dividends that OPG may make to the Province of Ontario.

Given the long timeframe over which Darlington will continue to operate, it was impractical to include data by year in this briefing. The supplementary data tables in Appendix B provide a more detailed economic analysis of the impacts of Darlington on consumer spending, investment, trade, employment by industry, and real GDP by industry.

**Table 3**  
**Impact of Continuing to Operate Darlington on Government Revenues (2017–55)**

Type of government revenue	(\$ millions)
<b>Total federal</b>	<b>13,787</b>
Taxes on income	13,586
Taxes on personal income	12,448
Taxes on corporate income	1,138
Taxes on products	198
Taxes on production	3
<b>Total provincial</b>	<b>9,299</b>
Taxes on income	8,783
Taxes on personal income	8,057
Taxes on corporate income	726
Taxes on products	416
Taxes on production	99
<b>Total municipal</b>	<b>356</b>
<b>Total taxes collected</b>	<b>23,442</b>

Sources: The Conference Board of Canada; Statistics Canada.

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The increased economic value resulting from Darlington Station's longevity represents an effectively permanent increase in Ontario's economy.

## Conclusion

Our economic impact analysis suggests that continued operation of Darlington Nuclear Generating Station will provide a significant and long-lasting boost to the Ontario economy, including an estimated total increase in Ontario's nominal GDP of \$75 billion between 2017 and 2055. Since the operation of Darlington has a low import content and heavy reliance on Ontario-based contractors, it creates an elevated total multiplier of 1.4. This means that, on average, for every \$1 of operational spending, Ontario's GDP will increase by \$1.40. Furthermore, the type II multiplier of 2.3 indicates that the total impact of operating Darlington until 2055 is more than twice as large as the contribution of utilities industry GDP associated directly with the station's operation. This elevated multiplier reflects the extensive economic footprint generated by Darlington beyond the utilities industry.

The operation of Darlington Station from 2017 to 2055 is projected to boost employment by an average of 14,200 jobs per year, increase personal income by a cumulative \$61.4 billion, and raise pre-tax corporate profits by \$7 billion. The increase in economic activity and the resulting increase in labour income and corporate profits boost the tax revenues of federal, provincial, and municipal governments by a total of \$23.4 billion over the station's lifespan. Of those revenues, \$13.8 billion goes to the federal government, \$9.3 billion to the Ontario provincial government (including interest payments made by OPG to the province), and \$356 million to local municipalities. Due to the longevity of Darlington Station, the increased economic value resulting from the station's operation effectively represents a permanent increase in Ontario's economy.

When considering the broader economic impact of the combined refurbishment and continued operation of Darlington, the station's footprint from 2010 to 2055 is projected to represent a total GDP impact of \$89.9 billion. The station's position as, effectively, a permanent feature of the Ontario economy will generate a total multiplier of 1.4. This translates into \$1.40 of economic value generated per dollar of combined investment and expenditure for refurbishing and continuing to operate Darlington Station.

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## APPENDIX A

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## APPENDIX B

# Supplemental Data Tables

**Table 1**  
**Darlington Station Continued Operation—Expenditures**

Indicator	2017	18	19	20	21	22	23	24	25	Average (2026–55)	Total (2017–55)	Annual Average (2017–55)
Total operational expenditures (current \$ millions)	1,169	1,151	1,146	1,150	971	1,091	979	1,090	1,539	1,499	55,259	1,417
Total operational expenditures (2015 \$ millions)	1,127	1,091	1,067	1,054	875	967	854	935	1,299	1,244	46,585	1,194

Sources: Ontario Power Generation; The Conference Board of Canada.

**Table 2**  
**Continued Operation Expenditure Impact—Key Economic Indicators**

(level difference, shock minus control, except where otherwise indicated)

	2017	18	19	20	21	22	23	24	25	Average (2026–55)	Total (2017–55)	Annual Average (2017–55)
GDP at market prices (2015 \$ millions)	1,275	1,245	1,236	1,224	1,014	1,119	986	1,085	1,507	1,441	53,925	1,383
GDP at market prices (\$ millions)	1,500	1,336	1,282	1,329	1,071	1,412	1,215	1,516	2,323	2,069	75,046	1,924
Personal income (\$ millions)	934	977	1,033	1,118	964	1,177	1,061	1,243	1,799	1,703	61,397	1,574
Personal disposable income (\$ millions)	629	649	683	738	631	771	690	808	1,172	1,101	39,788	1,020
Labour force (000s)	7.2	8.1	8.5	8.8	7.8	8.4	7.8	8.3	10.8	10.9		10.3
Employment (000s)	10.5	11.7	12.3	12.6	11.1	11.8	10.8	11.4	15.0	14.9	555*	14.2
Net operating surplus: corporation (\$ millions)	297	191	130	107	49	117	72	136	273	187	6,988	79

\*represents total person-years of employment  
Source: The Conference Board of Canada.



Table 3

**Continued Operation Expenditure Impact—Ontario Components of GDP (Expenditure-Based)**

(level difference, shock minus control, except where otherwise indicated)

	2017	18	19	20	21	22	23	24	25	Average (2026–55)	Total (2017–55)	Annual Average (2017–55)
<b>Current \$ millions (market prices)</b>												
Final consumption expenditures	1,399	1,248	1,162	1,171	943	1,220	1,051	1,274	1,934	1,740	63,616	1,631
Household consumption expenditures	1,254	1,088	1,007	1,001	803	1,027	885	1,067	1,614	1,454	53,369	1,368
Government consumption expenditures	130	141	128	136	108	157	134	174	280	246	8,770	225
Non-profit institutions consumption expenditures	16	19	26	34	33	35	32	33	41	40	1,475	38
Gross fixed capital formation	91	162	240	281	266	280	265	308	398	405	14,454	371
Residential investment	15	22	38	44	33	42	33	47	72	61	2,175	56
Non-residential investment in structures	29	52	70	73	63	64	58	65	88	90	3,262	84
Business and government investment in machinery and equipment	25	59	99	127	140	159	169	187	219	240	8,379	215
Investment in intellectual properties	1	2	4	5	4	4	4	5	7	6	227	6
Government investment in structures	21	27	29	32	27	10	1	4	12	8	411	11
Non-profit institutions fixed capital formation	0	0	0	0	0	0	0	0	0	0	0	–
Exports	186	149	137	149	110	194	157	226	379	309	10,958	281
Imports	176	223	257	273	249	281	257	292	388	386	13,982	359
Net exports	10	–74	–120	–123	–138	–87	–100	–66	–9	–77	–3,024	(78)
<b>GDP at market prices</b>	<b>1,500</b>	<b>1,336</b>	<b>1,282</b>	<b>1,329</b>	<b>1,071</b>	<b>1,412</b>	<b>1,215</b>	<b>1,516</b>	<b>2,323</b>	<b>2,069</b>	<b>75,046</b>	<b>1,924</b>

Source: The Conference Board of Canada.

Table 4

**Continued Operation Expenditure Impact—Ontario Components of GDP (Market Prices), Income-Based**

(level difference, shock minus control, except where otherwise indicated)

	2017	18	19	20	21	22	23	24	25	Average (2026–55)	Total (2017–55)	Annual Average (2017–55)
<b>Current \$ millions (market prices)</b>												
Compensation of employees	791	823	870	946	816	1,000	901	1,058	1,530	1,445	52,087	1,336
Wages and salaries	742	771	816	887	765	938	845	992	1,435	1,355	48,837	1,252
Employers' social contributions	49	52	55	59	51	62	56	66	95	90	3,250	83
Gross operating surplus	558	355	242	199	91	213	131	244	489	331	12,439	319
Net operating surplus: corporations	297	191	130	107	49	117	72	136	273	187	6,988	179
Consumption of fixed capital: corporations and government	261	164	112	92	42	96	59	109	216	143	5,452	140
Gross mixed income	131	138	148	163	145	178	164	192	273	264	9,446	242
Net mixed income	130	136	143	154	133	163	147	173	250	236	8,516	218
Consumption of fixed capital: unincorporated businesses	1	2	5	9	12	15	17	19	23	28	931	24
Taxes minus subsidies on production	9	9	9	9	8	9	8	9	13	13	459	12
Taxes minus subsidies on product and imports	12	12	12	13	11	12	11	12	17	17	614	16
<b>GDP at Market Prices</b>	<b>1,500</b>	<b>1,336</b>	<b>1,282</b>	<b>1,329</b>	<b>1,071</b>	<b>1,412</b>	<b>1,215</b>	<b>1,516</b>	<b>2,323</b>	<b>2,069</b>	<b>75,046</b>	<b>1,924</b>

Source: The Conference Board of Canada.

Table 5

**Continued Operation Expenditure Impact—Ontario. Real GDP (2015 \$ millions), Basic Prices, by Industry**

(level difference, shock minus control, except where otherwise indicated)

	2017	18	19	20	21	22	23	24	25	Average (2026–55)	Total (2017–55)	Annual Average (2017–55)
<b>Real GDP at basic prices (2015 \$ millions)</b>	<b>1,113</b>	<b>1,089</b>	<b>1,083</b>	<b>1,073</b>	<b>889</b>	<b>981</b>	<b>864</b>	<b>951</b>	<b>1,321</b>	<b>1,264</b>	<b>47,271</b>	<b>1,212</b>
Agriculture	6	6	6	6	5	5	5	5	7	7	248	6
Forestry	1	1	1	1	1	1	1	1	1	1	35	1
Support activities for agriculture and forestry	0	0	0	0	0	0	0	0	1	1	19	0
Fishing and trapping	0	0	0	0	0	0	0	0	0	0	0	0
Mining	2	2	3	3	3	3	2	3	4	4	132	3
Manufacturing	26	31	37	39	31	34	29	34	48	45	1,672	43
Construction	32	39	50	53	42	46	39	46	64	59	2,189	56
Utilities	699	676	662	653	542	599	529	580	805	771	28,880	741
Transportation and warehousing	11	11	11	11	9	10	9	10	14	13	485	12
Information and culture	16	16	16	15	13	14	13	14	19	18	686	18
Wholesale and retail trade	52	50	49	49	41	45	40	43	60	58	2,159	55
Finance, insurance and real estate	161	153	147	144	120	133	118	128	177	170	6,387	164
Community, business, and personal services	73	71	71	70	58	64	57	62	86	83	3,090	79
Public sector (including education, health, and public administration)	34	32	30	29	24	27	24	26	36	34	1,286	33

Source: The Conference Board of Canada.

Table 6

**Continued Operation Expenditure Impact—Ontario. Employment, Annual Averages, and Total Person-Years, by Industry**

(level difference, shock minus control, except where otherwise indicated)

	2017	18	19	20	21	22	23	24	25	Average (2026–55)	Total (2017–55)	Annual Average (2017–55)
<b>Total employment</b>	<b>10,485</b>	<b>11,670</b>	<b>12,255</b>	<b>12,572</b>	<b>11,054</b>	<b>11,784</b>	<b>10,773</b>	<b>11,443</b>	<b>15,007</b>	<b>14,932</b>	<b>555,013</b>	<b>14,231</b>
Agriculture	74	93	97	95	80	81	73	75	98	98	3,697	95
Other primary sector	5	9	12	14	13	12	11	11	14	15	537	14
Utilities	7,208	7,444	7,636	7,776	6,782	7,418	6,749	7,270	9,647	9,431	350,860	8,996
Manufacturing	141	229	293	323	289	286	259	272	349	360	13,235	339
Construction	194	433	606	721	681	635	591	585	733	814	29,598	759
Wholesale and retail trade	851	1,001	1,026	1,018	873	906	819	857	1,129	1,132	42,441	1,088
Transportation and warehousing	92	144	153	152	133	130	121	122	157	166	6,172	158
Finance, insurance, real estate	325	480	526	539	486	487	452	457	568	591	22,050	565
Other commercial services	1,191	1,336	1,437	1,485	1,332	1,434	1,330	1,423	1,826	1,826	67,583	1,733
Public sector (including education, health, and public administration)	403	500	469	449	385	396	369	371	486	501	18,861	484

Source: The Conference Board of Canada.



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